DOCUMENT RESUME

ED 085 857 EA 005 739

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TITLE Reading and Mathematics Achievement of Grade 3 Pupils in Open Plan and Architecturally Conventional Schools--the Third Year of a Longitudinal Study. Studies of Open Education No. 10.
INSTITUTION York County Board of Education, Aurora (Ontario).
PUB DATE Oct 73
NOTE 18p.; Related documents are ED 067 725 and ED 081 081-083

EDRS PRICE MF-$0.65 HC-$3.29
DESCRIPTORS *Academic Achievement; Case Studies (Education); *Comparative Analysis; Elementary Grades; *Grade 3; Intelligence Tests; Mathematics; Open Education; *Open Plan Schools; Reading Achievement; School Architecture; Test Results; *Traditional Schools
IDENTIFIERS Ontario; York County

ABSTRACT

In the spring of 1973, a standardized test of reading and mathematics skills was administered to 564 grade 3 pupils distributed among two open plan schools (155 pupils) and seven conventionally constructed schools (409 pupils). The groups were matched on IQ, geographic location, the academic qualifications of their teachers, and average class load. This was the third and final year of a longitudinal ability and achievement study of this pupil cohort. As in the previous two years, the marginal differences in achievement as disclosed by test results were neither consistent nor significant. Over the three schools years, beginning in September 1970, no significant differences were found in the academic ability and scholastic achievement levels between the pupils in the two sorts of architectural settings. No consistent patterns were discernible; some differences might be attributable to factors other than architecture, since it was impossible to control all the variables (e.g., years of teaching experience) that might reasonably have affected the learning situations under study. (Author/MLF)

STUDIES OF OPEN EDUCATION

Titles in Series

No. 1	The Open Plan School as a Response to Change (Jon. 1970) (reprinted April 1973)
No. 2	A Day in the Life: Case Studies of Pupils in Open Plan Schools (May 1970)
No. 3	Anatomy of Open Education: A Barebones Summary of Its Assumptions as Related to Practices in Elementary Education and an Overview of Its Accomplishments (revised Sept. 1970)
No. 4*	"Open Education: A Selected Bibliography" (revised Oct. 1970)
No. 5	Reading and Mathematics Achievement of Grade 1 Pupils in Open Plan and Architecturally Conventional Schools (Sept. 1971) (reprinted April 1973)
No. 6	Reading, Spelling, and Mathematics Achievement of Grade 2 Pupils in Open Plan and Architecturally Conventional Schools (Mar. 1973)
No. 7	Curiosity and Creativity Among Pupils in Open Plan and Architecturally Conventional Schools -- A Progress Report (Mar. 1973)
No. 8	Problems of Teacher-Student Organisation in Openrooms (April 1973)
No. 9	Development of Children's Moral Reasoning Power (June 1973)
No. 10	Reading and Mathematics Achievement of Grade 3 Pupils in Open Plan and Architecturally Conventional Schools -- The Third Year of a Longitudinal Study (Oct. 1973)

* Out-of-print

Research Office

Division of Planning and Development The York County Board of Education

READING AND MATHEMATICS ACHIEVEMENT OF GRADE 3 PUPILS IN OPEN PLAN AND ARCHITECTURALLY CONVENTIONAL SCHOOLS THE THIRD YEAR OF A LONGITUDINAL STUDY

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SYNOPSIS

In the spring of 1973 a standardized test of reading and mathematics skills was administered to 564 grade 3 pupils distributed among two "open plan" schools (155 pupils) and seven conventionally contructed schools (409 pupils). The groups were matched on IQ, geographic location, the academic qualifications of their teachers, and average "class load." This was the third and final year of a longitudinal ability and achievement study of this pupil cohort.

As in the previous two years, the marginal differences in achievement were neither consistent nor significant. As in grade 1 (1971) and grade 2 (1972), pupils in the open plan schools were, on the average, perhaps fractionally better readers. On the other hand, the pupils in the traditionally built schools scored higher in mathematics by about the same insignificant margin (about one raw score point on a battery of 115 items).

Over the three school years, beginning in Sept. 1970, no significant differences were found in the academic ability and scholastic achievement levels between the pupils in the two sorts of architectural settings. Previous and parallel studies[1] have investigated other dimensions -- pupils' creativity and curiosity; pupils' attitudes toward school; teachers' expectations and the possible effect of these expectations on pupils' achievement; pupils' development of moral reasoning power

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[1] The earlier studies in this series are noted on the first page of this report.

in the two settings; pupils' opportunities to share in decision-making, to initiate learning activities, to raise pertinent questions and to discover their own answers, etc. While the marginal differences have tended to favour pupils in the open plan schools, this was not the case in all instances. The differences were of a magnitude which could be considered chance occurrences. No consistent patterns are discernable; some differences may be attributed to factors other than architecture, as it was not possible to control all the variables (e.g., years of teaching experience) which might reasonably affect the learning situations under study.

DETAIL

(a) Purpose of this Series of Studies and Some Early Findings

When the York County Board of Education came into being in 1969, it inherited four open plan schools which had been designed by predecessor elementary school boards. The new board, both trustees and administrators, could not immediately say whether these schools featured more than architectural innovation, whether they also practised "open education" and, if so, what that entailed. The educational effectiveness of these new schools was also to be determined.

A series of interrelated studies was begun in 1969-70, some undertaken cooperatively with external researchers. It was hoped that the educational nature of "openness" might be clarified, and that it might be possible to determine the extent to which open education practices prevailed in older, conventionally constructed schools.

It seemed desirable to identify the behavioral outcomes educators might expect of open education programs and to determine whether desired objectives were

being met. It also seemed essential to determine whether, in striving for their particular goals, open plan schools had undesirable side-effects. For instance, were they offering a less effective program, as judged by "traditional" yardsticks (such as achievement in reading and mathematics skills), when compared with other schools which resembled them in some major particulars but not in architecture and its (assumed) concommitant differences in program organization?

In 1969-1970 the first titles in this present series were published. These works helped to define the nature of open education, both at theoretical and practical levels. Case studies of pupils at all elementary grade levels in both open plan and matched "control" schools were conducted. In the spring of 1970 it was possible to report findings to the board. Pupils in open plan schools were, in the opinion of the observers (public school principals), more likely: to be allowed to initiate learning activities including those which reflected their own interests; to be given and to put to good use some responsibility for their own learning; to raise pertinent questions; and to participate in cooperative planning with teachers; than were pupils in the matched "conventional architecture" schools.

These case studies also showed that some "open education" concepts and practices were embodied in the programs of schools with conventional architecture. Pupils in both settings had equal opportunity to display personal responsibility, for instance, and they displayed equal regard toward others. In one of the two open plan schools, some degree of "structure" was provided for many pupils, especially for those identified as needing remedial teaching or special education programs. A recheck in 1973 found this "structuring" had been continued, even extended. About 40 per cent

of the grade 3 pupils in that one open plan school had at least some of their program in an architecturally and programmatically non-open setting and fashion.

In the autumn of 1970 the board authorized studies into other dimensions of education where it was thought that open plan schools might produce different outcomes. The studies into differences in creativity and curiosity, attitudes and expectations, and into moral reasoning (interpersonal valuing) power, have proceeded into 1973, with interim or final reports as indicated elsewhere. At present, only a report on attitudes and "expectations" remains outstanding. In these various studies to date, no consistent differences have been identified between pupils in one setting or another. The same conclusion holds for the three-year study of achievement which is the subject of this report.

(b) Limitations of this Study

In previous reports much has been said about the dangers of over-emphasizing the results of tests which measure the cognitive (intellectual) attainments of rather young children. It was observed that, in kindergarten and grades 1 and 2 many teachers stress personal and social growth, encourage articulateness even at the expense of correctness, work at "readiness" skills rather than at paragraph comprehension, and arrange opportunities for concrete experience with materials rather than with abstract concepts. Such concerns are less to the point in grade 3, however, as cognitive skills development is more central to programs at this stage.

Difficulties with the mechanics of paper-and-pencil tests were noted in previous years. The grade 3 pupils, and the schools too, seemed to find the 1973 testing easy to take in stride. There was no evidence of invalid administrations and an item-analysis procedure provided cross-checks on the manual scoring of the tests which, this year, was done in the Research Office, rather than by the teachers.

The twin problems of attrition -- loss of pupils during the life of a longitudinal study due to transfers out of the school -- and accretion -- the addition of pupils who transfer into a school -- are considerable over a three-year span. While attrition has been moderate with respect to individual pupils, one conventionally built school was dropped from the study when its population was depleted due to the construction of another school adjacent to it. In-migration has been considerable especially to the open plan schools. In one instance, the closing of small neighbouring rural schools caused a dramatic jump in enrolment. After such "new" pupils had been in either the open plan or conventional schools for two years there was no logical reason for excluding them from the study, save the questionable tradition of studying only the "survivors" in long-term studies. Clearly, the populations in any setting at the beginning and end of this study are rather different, especially at open plan school "B," which grew over the period from 20 to 46 pupils in the grade under study. The alternative, to continue only with the survivors, would overlook the real-life facts that families (as well as school boundaries) move about, that children are normally exposed to more than one style of school architecture or educational philosophy, and that schools are expected to answer for the progress of transfer-in pupils.

(c) Method

Much of the detail concerning the origin and first years of this study can be found in earlier titles in this series.[2] The following resume is intended only as an overview of earlier information and to link it meaningfully to the 1973 investigations.

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[2] Specifically, see Studies #2, #5, and #6.

A study in 1969-70 (reported as A Day in the Life) helped to determine certain degrees of dissimilarity between the County's open plan elementary schools (at that time there were four) and three conventionally built schools which resembled them in certain other ways. From experience gained in examining many facets of the school's operations, it was possible to devise guidelines for further studies in which open plan and conventionally built schools could be "paired" for the purpose of comparing outcomes. School principals were involved in this process and there was consensus that comparative studies of achievement were most feasible where the following conditions could be met. The minimum enrolment of 300 pupils should be spread across at least seven years, beginning with kindergarten (e.g., K-6 or K-8), and that the study should be longitudinal, proceeding from grade 1 and lasting a minimum of three years. The communities should resemble each other (e.g., in socio-economic status, geography), preferably being contiguous. Comparisons of achievement should be "controlled" by (i.e., take into account) ability measures. The numbers of pupils studied should be as great as possible (i.e., whole population of any grade under study, not just a sample) and care should be taken not to exclude "special cases" (e.g., special education classes, transferees) without good cause. From experience, it was thought unlikely that all conditions which varied randomly (e.g., class load, teaching experience) could be controlled. These variables could be examined in detail if meaningful differences in pupil performance were found, in which case there would be some need to account for the findings. It was taken as read that standardized tests would need to be used, that teachers would be consulted on the appropriateness of the tests, and that usual methods of controlled research would be followed.

It was not considered feasible to try the random assignment of pupils to schools of the two types, or to select schools at random, however ideal this appears to research theorists, until a strong need justified such actions.

In the autumn of 1970 the principals of the County's two open plan schools which operated K-7 programs and of 17 other (conventional architecture) schools volunteered to participate in a three-year longitudinal study of achievement. Before the initial tests (spring 1971) the two open plan schools were "paired" with a total of nine schools which, collectively, were more-or-less comparable with respect to the variables previously judged important. (The number of "paired" schools was reduced to seven by 1973 due to boundary changes which caused considerable alteration in their nature to two schools.) The nine other volunteer schools served to give "background" readings to the various test scores, representing as they did the achievement patterns to be found across the County.

For the 1973 testing program, the open plan and their "control" (or "paired") schools were judged comparable with respect to the communities they serve, to the academic (cognitive) ability of the pupil cohort under study, and to the qualifications of the teachers as well as the mean average class loads borne by the teachers.

All grade 3 pupils in the present study previously took one, or both, of the Canadian Cognitive Abilities Test (1970 edition), Primary 1 battery (given to grade 1 pupils in 1971) and the Primary 2 battery (given to grade 2 pupils in 1972). In both years Form 1 of the test was administered. These test data were used to reconfirm the comparability of the open plan and control groups.

In those same years the pupils also wrote the Metropolitan Achievement Test (1970 edition) batteries, Primary 1 (Form G) in 1971, and Primary 2 (Form F) in 1972. The mathematics and reading batteries were given both years, with spelling also given in 1972. Due to the very high spelling scores in grade 2, it was decided against using the spelling battery in grade 3.

In the spring of 1973, the reading and mathematics tests of the Elementary Battery of the Metropolitan Achievement Tests (Form G) were administered to about 1100 grade 3 pupils in 18 schools. This battery is recommended for use from mid-grade 3 to the end of grade 4. The reading tests consisted of a word knowledge or vocabulary section (50 items) and a reading comprehension section (45 items). The mathematics score is similarly an aggregate of results from a computation section (40 items), a mathematical concepts section (40 items), and a problem-solving section (35 items).

(d) Findings

For 1973, as with the preceding two years, analyses of variance have been carried out for three different comparisons. First, the means of scores attained in the two open plan schools were compared with means obtained in the seven control schools. Second, the means of each of the open plan schools were compared with the means of that school's controls. Finally, the means of all the pupils in the open plan schools were compared with the means of the pupils in all 18 schools. The means of the pupils in the seven control schools were similarly compared with the means of the pupils in all 18 schools.

As in previous years, the means of the pupils in the open plan and conventional schools did not differ in either a practical or statistically significant degree. As Table 1 shows, the mean reading scores differed by one raw score point (52.4 vs 51.4) on a 95-item battery, and favoured the open plan pupils. On the mathematics battery of 115 items, the difference this time favoured the control school grade 3 population, 62.6 to 61.5, or just better than one raw score point. The very considerable variance of scores within groups was noted as in 1971 and 1972.

TABLE 1: ACHIEVEMENT OF GRADE 3 PUPILS IN OPEN PLAN AND ARCHITECTURALLY CONVENTIONAL SCHOOLS (GROUPED BY TYPE)

School Type	No. Schools	No. Pupils	Mean IQ	Mean Achievement Reading	Mean Achievement Mathematics
Open Plan	2	155	105*	52.4	61.5
Conventional	7	409	106*	51.4	62.6
County Sample	18	1085	109*	57.2	70.0
Test Norms			100**	53.0	62.0

* On Canadian Cognitive Abilities Tests

** On Otis-Lennon Mental Abilities Test

Comparisons were made between mean scores of each open plan school and its controls. Open plan school "A" pupils outperformed pupils in its controls significantly in reading (.01) but not in mathematics. Pupils in open plan school "B"

performed markedly less well in reading (significant at .01) and mathematics (.05), reversing what had been observed in both the preceding years. Table 2 provides details.

TABLE 2: ACHIEVEMENT OF GRADE 3 PUPILS IN OPEN PLAN AND ARCHITECTURALLY CONVENTIONAL SCHOOLS (PAIRED)

School	No. Schools	No. Pupils	Mean IQ	Mean Achievement Reading	Mean Achievement Mathematics
Open Plan "A"	1	109	105	57.2	61.6
"A's" Controls	3	190	108	50.8	61.2
Open Plan "B"	1	46	106	45.4	61.4
"B's" Controls	4	219	105	51.9	64.0

As Table 1 shows, the means of pupils in the open plan schools and also the pupil means in their conventionally built controls were substantially less than the mean average scores attained by all grade 3 pupils in the 18 schools in this testing program. Even when the differences in ability ("IQ") are taken into account in the analyses, the achievement differences are still greater than could reasonably be attributed to chance variations ($p = .05$).

The publisher's test norms are included in Table 1. The achievement scores in the nine schools under study do not vary much from the norm group scores.

In previous years achievement scores have been reported as grade equivalent (GE) scores and, sometimes, also as percentile (%ile) scores. In Table 3 the mean

TABLE 3: ACHIEVEMENT, AS GRADE EQUIVALENT AND PERCENTILE RANK SCORES, OF GRADE 3 PUPILS IN OPEN PLAN AND ARCHITECTURALLY CONVENTIONAL SCHOOLS

School	Vocabulary		Reading Comprehension		Total Reading		Math. Comput.		Math. Concepts		Math. Problems		Total Math.	
	GE	%ile	GE	%ile	GE	%ile	GE	%ile	GE	%ile	GE	%ile	GE	%ile
Open Plan "A"	3.9	58	3.7	60	3.7	58	3.7	42	3.8	50	3.8	52	3.7	48
Control A-1	3.5	46	3.1	42	3.3	42	3.7	42	3.8	50	3.6	48	3.6	44
Control A-2	3.6	48	3.6	56	3.5	50	4.4	74	3.9	56	4.2	66	4.1	62
Control A-3	3.4	42	3.3	46	3.3	42	3.5	34	3.6	46	3.6	48	3.5	38
Open Plan "B"	3.5	46	3.1	42	3.2	40	3.9	52	3.5	42	3.7	50	3.7	48
Control B-1	2.8	24	3.0	38	2.8	28	4.0	58	3.4	38	3.4	40	3.6	40
Control B-2	3.7	52	3.6	56	3.6	54	3.9	52	3.7	46	3.7	52	3.7	48
Control B-3	3.9	58	3.8	64	3.8	60	3.8	48	4.0	58	4.0	58	3.9	56
Control B-4	3.8	56	3.7	60	3.7	58	4.3	70	4.4	68	4.0	58	4.3	68
County Sample	3.8	56	3.7	60	3.7	58	4.0	58	4.1	64	4.0	58	4.0	60
Test Norm*	3.7	52	3.4	48	3.5	50	3.8	48	3.8	50	3.6	48	3.7	48

* Approximation only available for this period of the year.

achievement scores, by school, for each subtest and for "total reading" and "total mathematics" are given as grade equivalents. In addition, each mean raw score for each test, by school, has also been treated as if it were an individual score, and a percentile ranking found for that score. These converted scores will be mainly of interest and use in schools where such data have been compiled over the life of this study.

In receiving the report of the grade 2 achievement testing program, the York County trustees asked whether certain additional information could be included. Specifically, data were requested on the experience and qualifications of the teachers of the pupils under study, and the ratio of men to women teachers. They also wished to know whether the open concept schools had "closed" areas where "slow learners" were placed.

The definition of "qualifications" and "experience," to the layman, may present some semantic problems. For this study we have held to the legalistic criteria used by the board for pay purposes. Depending on preservice education and training, every elementary school teacher is categorized numerically, 1 being the minimum and 4 the maximum category. Degree status is reflected in the category scheme. Experience is calculated in years (or partial years) and normally corresponds to the number of years previously employed as a teacher (or closely related activity).

Average class load was calculated by school and by school type. "Class load" represents the actual number of pupils in the charge of any teacher. Or, in the case of open plan schools, it may represent the number of pupils supervised by a team of teachers, divided by the number of teachers. In some schools where there were mixed

grades (or continuous progress, ungraded) classes, the class load definition still holds, but it is understood that not all pupils would necessarily be characterized as "grade 3" pupils.

As Table 4 shows, when the mean averages for the open plan schools (on the one hand) are compared with the averages for the conventionally built schools (on the other), the qualifications and class loads are nearly the same. The control schools do have a marginally better class load factor, and their teachers are of somewhat higher average category, but the difference is slight.

The average teaching experience of the control schools' staff, 6.2 years, is markedly greater (nearly 150 per cent) than that of the open plan staff, 4.2 years. The difference needs to be interpreted in the light of another factor. In open plan school "B," a change of staff occurred at the beginning of January. The replacement teacher (a degree holder but with only one year's experience), a male, was just returning to teaching.

The data on the ratio of male to female teachers, and the number of degree holders, is given as requested. This data base is too thin for much more than personal judgment.

More meaningful are the differences in experience and class loads. In open plan school "A" some 108 grade 3 pupils (mean IQ of 105) were supervised by only three teachers, but achieved as well as pupils (mean IQ of 108) under teachers with more experience and lighter class loads in their control schools. In open plan school "B," where a relatively light class load existed, pupils did not perform as well as pupils of comparable ability but who had better qualified and more experienced teachers.

TABLE 4: STAFF QUALIFICATIONS, EXPERIENCE, CLASS LOADS, AND RATIO OF MALE TO FEMALE TEACHERS

School	No. Teachers	Ratio Male: Female Teachers	Average Years Experience	Average Category	No. With Degrees	Average Class Load
Open Plan "A"	3	0:3	5.0	2.3	1	36.0
"A's" Controls	6	1:5	7.9	2.3	1	30.7
Open Plan "B"	3	*1:2	3.3	2.1	1	25.3
"B's" Controls	9	1:8	4.8	2.3	2	28.9
Open Plan A and B	6	*1:5	4.2	2.2	2	30.7
Controls	15	2:13	6.2	2.3	3	29.8

* A female teacher was replaced by a male teacher at the beginning of January.

The best by-school performances of all come from pupils of lower (for this cohort) average ability (100), average class load (30), but high teacher experience (11.5 years).

The range of experience differed between the two types of school. The open plan school teachers had from one to seven years' experience, while in the other group the experience ranged from no years to 18 years.

DISCUSSION

The longitudinal achievement studies were originally undertaken for several reasons, among these the voiced fear that achievement in traditional dimensions (such as reading and mathematics) might be sacrificed in open architecture settings.

At this juncture the only reasonable interpretation of the achievement data gathered over the years is that we must look elsewhere for differences, if they are to be found in the Primary Division.

Perhaps one needs to look at individual cases rather than at group data. For instance, case studies of children not promoted (or placed in special education, more likely) or of children who have done exceptionally well, might throw light on the sorts of program specifics which correlate with success or failure of different sorts of pupils.

Given the persistent "no significant difference" findings, plus the cumulative attrition-accretion threat to the study's validity, this seems the time to end this inquiry. Since all grade 4 pupils will be tested with the Metropolitan Achievement Test batteries in the spring of 1974, it would be possible to work through the data when and if the need is felt.

At this point in time many other jurisdictions are reporting studies on open education. It would perhaps be useful to devote research attentions to these studies before a new cycle of investigation is decided upon. This might also be an appropriate time to bring the "second generation" of York's open plan schools into purview.